Name_____

This is Harold Kaplan's second project in SM162. It is handed out Monday 14 February 2005. It is due back Tuesday 22 February 2005, in class on paper, not e-mailed. A project is like an hour test and must be completed without help from anybody except Harold Kaplan. Kaplan will help in class, but not in extra instruction. You may use your own notes and any commercially prepared materials you choose. For each problem, hand in printouts (or pencillings) of program and answer and graph. For approximate integrals, explain why you think "n" is big enough. Each answer ought to go on the same paper as its program. The programs ought to have blank lines and indentation to show structure. Use `formatlong()` in every Lua program that prints an answer. Use the "ax" on each program, so it has no lines but those necessary. Using calculus is permitted.

1 Write and run a Lua program to make a table of natural logarithms for integer x from 1 to 20. Use the definition of the logarithm in our syllabus, not the `log` function of Lua. Use the midpoint rule and n=100 steps.

2 Write and run a Lua program to make a table of natural antilogarithms for integer x from 0 to 10. You may use the `log` function of Lua, but not the `exp` function. Use a tolerance of one over a million.

3 For information theory I need a function called `logbasetwo` to give programmers a logarithm to the base two. Write a Lua function for this, making use of the `log` function of Lua, and save it into a file called `logbasetwo.lua`. Then test your function by writing and running a program to call it, for the pupose of printing a table of logarithms to the base two of whole numbers from 20 to 30 inclusive. Remember to use `dofile`.

4 The probability books say that $\int_{-\infty}^{\infty} \frac{\exp\left(\frac{-x^2}{2}\right)}{\sqrt{2\pi}} dx = 1$, but I have my doubts. Write and run a numerical program in Lua to find out the value of that integral with an error no greater than one over a thousand, in order to keep the people honest. (First hint: the integrand is symmetric around the vertical axis. Second hint: for $x > 2$, the $\exp(\frac{-x^2}{2})$ in the numerator is bounded by $\exp(-x)$.)

Hand this question sheet in with the answer sheets.